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# 5G Video Production

Remote and distributed, ultra-low latency video production workflows using the cloud, edge computing and 5G.

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# Introduction

## Across the broadcast and media industry, we have been waiting to see the true potential of 5G for live video production.

So, alongside our friends and colleagues at AWS, we have collaborated on a new project to demonstrate what is possible in this emerging sector. Together, we have created a public preview of a working 5G-powered, remote live production workflow using Grabyo, AWS Wavelength and 5G technology.

The public preview is a robust, fully cloud-based live video production workflow that utilises 5G and edge compute, to provide an experience that can rival traditional on-premise or even remote production (REMI) tools.

However, unlike traditional tools, this setup aims to offer total flexibility - it allows production crew to work from different locations remotely, in a collaborative environment. Cloud production removes the need for much of the traditional hardware, infrastructure and human resource needed on site for live production, whilst 5G connectivity allows for free roam of cameras, capture sites, as well as of the production crew.

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We tested the build in two different geographical locations - London and New York, using 5G networks provided by mobile network operators Vodafone and Verizon, in 2 different AWS Wavelength Zones. In this report, we will share how we built it and what the future holds for the role of 5G in live video production.

This public preview shows the true potential of 5G-powered, distributed live production. This is the first step and we are excited about the possibilities to continue developing this solution to provide an untethered, limitlessly scalable, ultra-low latency live production workflow.

We hope you enjoy reading - if you have any questions please contact our team at **hello@grabyo.com**

Mun Wai Kong
CTO, Grabyo

# The challenge

## Our aim was to demonstrate the art of possible and to investigate how to replace traditional Outside Broadcast (OB) trucks with cloud-based, 5G production workflows.

Grabyo's cloud-native video production platform currently enables broadcasters and rights holders to produce high-quality live video in a cost-efficient and scalable platform, from anywhere in the world.

By moving away from traditional hardware solutions, which require expensive CAPEX investment and are not scalable on demand, broadcasters and publishers can leverage the elasticity and scalable nature of cloud computing to meet the needs of their complex workflows.

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While services such as AWS EC2 enable compute capacity to be moved to the cloud, managing latency and throughput between the video source, production crew, and the server in the cloud, remains a challenge.

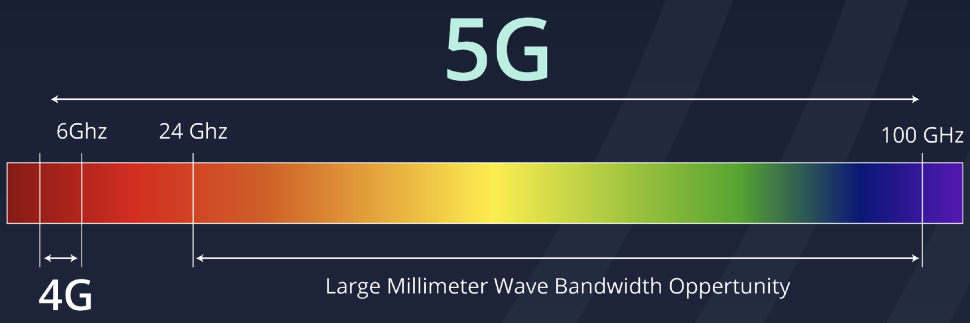
The current options to solve the latency and throughput issue are a trade-off in either cost (utilizing inflexible and expensive fiber connections or satellite) or viewer experience (reducing video quality using heavy compression over public internet).

As 5G rolls out, we wanted to explore new technical solutions to solve this production challenge.

# Understanding 5G

## Before we deep dive into the workflow, let's cover off the basics of 5G, and which features and terms are relevant to video production.

### Lower latency, higher throughput




5G uses a much wider frequency spectrum and can be operated at higher frequencies i.e. 3-4 GHz (mid-band) or 24-30 GHz (high-band) compared to 4G which operates within the 800MHz and 2.6GHz bands.

As 5G operates in this higher GHz spectrum, there is more bandwidth available, especially towards the higher end, which allows for more data to be transported quickly.

What this means is that using 5G, you are able to send more data (which translates to higher fidelity, higher quality streams) to your destination at much faster speeds than the current 4G spectrum. This greatly reduces the latency from video capture to your production tools, and then to your audience.

### Higher capacity, less congestion

Operating on these wider frequency bands also allows for more capacity within mobile networks allowing for more data to be transferred in highly congested and densely populated areas without interruption.

Lower contention for network bandwidth and higher data throughput are crucial for reliable transmission of high-definition video streams to your production instance in the cloud.

## Network slicing

Slicing is a unique feature of 5G and will offer further reliability for live productions, especially in heavily congested areas.

Using network slicing, you are able to reserve a 'slice' of the 5G spectrum, which means your devices will not compete with anyone else for bandwidth in that slice. This is not possible when data traffic is on a contended network, such as 4G and WiFi, which becomes a major problem in densely populated or congested areas, such as sports stadiums, where many thousands of people may be using the same mobile phone or cell tower at the same time.

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As more 5G devices such as smartphones are used, competition for connectivity will increase in densely populated areas. In a sporting venue, a broadcaster may choose to reserve a slice of the 5G network to ensure their production does not compete for 5G bandwidth with thousands of people in the immediate coverage area.

Network slicing is an enterprise-level feature that will be available to broadcasters and media organizations working with network operators in the future.

# Edge Computing

## AWS Wavelength makes available the reliable and scalable AWS cloud compute services, like EC2, directly within 5G networks - providing a mobile edge compute infrastructure.

Latency-sensitive applications and workflows benefit from edge computing by cutting down the time taken for data to travel from client to server and back. Instead of a data packet having to traverse across the public internet originating from their 5G device in New York all the way to a server hosted in an AWS region (i.e. North Virginia), it can now cut short that travel time with the server provisioned within the New York Wavelength zone.

AWS Wavelength enables Grabyo to deploy its live production services as close as possible to connected 5G devices. The edge computing architecture ensures that the ultra-low latency capabilities of 5G is taken advantage of - enabling real-time workflows and applications such as live video production in the cloud.

# The Build

Our 5G-powered distributed production workflow was built combining the technologies of:

- **Verizon and Vodafone**
- **5G networks**
- **Grabyo**
- **Amazon Web Services**
- **AWS Wavelength (edge computing)**
- **Cloud-based video production platform**

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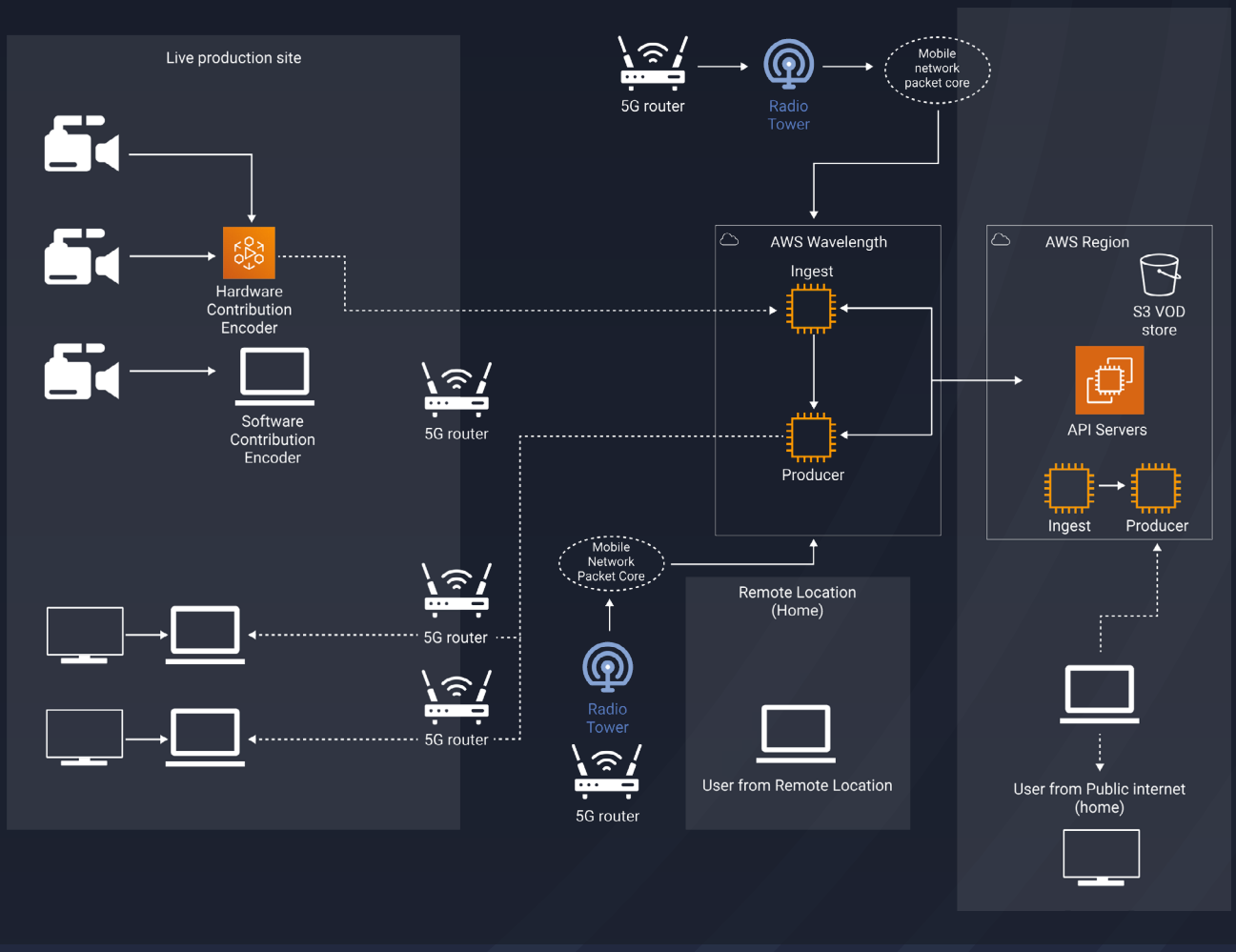
The diagram below illustrates at a high level the setup of Grabyo's fully distributed cloud-native remote live production instance, powered by 5G and Wavelength. At the source location, HD cameras and video encoders were connected to 5G routers, which provided the contribution feeds directly to the AWS Wavelength Zone. An instance of Grabyo Producer iwas provisioned within this Wavelength zone to receive these low-latency video signals and provide live production capabilities such as camera switching, vision mixing and audio mixing in real-time.

Simultaneously, production crew members, using only their laptop and their web browsers, connected to the Grabyo Producer user interface, allowing them to collaborate in real-timeto produce the live event from different geographical locations, connected by 5G.

This build was replicated across two regions in order to test 5G availability across different network providers. During our tests, we witnessed the incredible bandwidth speeds of 5G, up to 240 Mbps download and 45 Mbps upload, and a round-trip latency as low as 9ms. These results provided a dramatic uplift when compared to its 4G counterparts, where bandwidth speeds only reached 30 Mbps download and 10 Mbps upload as well as higher round-trip time latencies (20-50ms).




The Build

It is important to note that these test results are of a point in time, and that as 5G infrastructure roll out matures around the world, we expect to see further improvement in bandwidth speeds and latencies, reaching the theoretical boundaries of 5G technology of consistent single-digit millisecond latency and gigabit per second throughput, especially with the use of 5G's millimeter wave (mmWave) spectrum.

These tests were also run in Non-Stand Alone (NSA) 5G environments, however with Stand Alone deployments we can expect to see increased performance in many locations.

# Future benefits

## Our project has laid the foundations for how we will deploy 5G-powered video production solutions to the broadcast and media industry in the near future.

Here are some of our takeaways from the test and what to expect once you are able to adopt 5G and cloud tools into your video production workflows.

### Untethered production

Ultra-low latency video transport and production without any cables. From 5G cameras to vision mixing and live production in the cloud, using just a laptop.

Once 5G is available everywhere, you could send a skeleton crew on-site to operate cameras, microphones and encoders, which in turn can be directly connected to production services in the cloud and operated by remote teams, distributed across multiple locations.

### Peace of mind

5G for video production will allow you to increase your mobility and flexibility, reducing the reliance on fixed and expensive fiber or satellite connections without the trade-off in quality and cost. 5G connectivity can be highly reliable, especially when using network splicing.

The latency benefits of 5G and AWS Wavelength are also hugely important for remote, high production value events. The combination of using Grabyo with AWS Wavelength enabled production services to move to the “edge of the network” and closer to the users. 5G access then gave everyone a low latency connection to the production environment from wherever they were located.

## A glimpse of a sustainable production future

Sustainable production is an increasingly important objective for the broadcast and production industry. With a reliable, remote working infrastructure in place using 5G and the cloud, reducing the amount of air, road and rail travel will help to significantly reduce the carbon footprint for broadcasters and media publishers.

## Reduced capital investment

Traditional hardware or software licenses have high up front costs and a regular replacement cycle with limited upgrade options. Customers will usually need to overbuy capacity and upgrade equipment regularly to access the latest features.

In the cloud, features are released directly to the platform providing a continuous stream of upgrades and enhancements, available the next time you open your browser. This includes upgrades to underlying compute and video infrastructure meaning customers can benefit from developments in compute hardware and processing power without buying new equipment.

The move from Capex to Opex for cloud video services is another benefit to content producers. Cloud production services can be delivered as a pay-as-you-use model, which means you don't need to invest heavily upfront and often, but pay for what you need, when you need it.

# Our thoughts

## Mun Wai Kong

CTO, Grabyo

"At Grabyo we are on a mission to deliver broadcast-grade production tools in the cloud, and this project has shown the true potential of cloud production services in replacing inflexible hardware and on-prem equipment.

We have taken a big step towards that future and we are excited about the developments with AWS Wavelength and 5G video production that will become an important part of the video industry in the coming years."

# Thanks for reading!

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